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Of Attorneys for Amicus Curiae, The Confederated Tribes
Of the Warm Springs Reservation of Oregon, Confederated Tribes
Umatilla Indian Reservation, and Yakima Nation

UNITED STATES DISTRICT COURT
DISTRICT OF OREGON

NATIONAL WILDLIFE FEDERATION, et al.,

Plaintiffs

and,

STATE OF OREGON

Intervenor-Plaintiff

v.

NATIONAL MARINE FISHERIES SERVICE, U.S. ARMY CORPS OF ENGINEERS, and U.S. BUREAU OF RECLAMATION,

Defendants,

and

Case No. 01-0640-RE (Lead Case)
CV 05-0023-RE (Consolidated Cases)

DECLARATION OF WILLIAM J. BOSCH IN SUPPORT OF MEMORANDUM OF AMICI WARMS SPRINGS, UMATILLA, AND YAKAMA TRIBES IN OPPOSITION TO MOTIONS FOR SUMMARY JUDGMENT

NORTHWEST IRRIGATION UTILITIES, PUBLIC POWER COUNCIL, WASHINGTON STATE FARM BUREAU FEDERATION, FRANKLIN COUNTY FARM BUREAU FEDERATION, GRANT COUNTY FARM BUREAU FEDERATION, STATE OF IDAHO, INLAND PORTS AND NAVIGATION GROUP, and KOOTENAI TRIBE OF IDAHO,

Intervenor-Defendants.

COLUMBIA SNAKE RIVER IRRIGATORS ASSOCIATION and EASTERN OREGON IRRIGATORS ASSOCIATION,

Plaintiffs,

v.

CARLOS M. GUTIERREZ, in his official capacity as Secretary of Commerce, NOAA FISHERIES, and D. ROBERT LOHN, in his capacity as Regional Director of NOAA FISHERIES,

Defendants.

I, WILLIAM J. BOSCH, HEREBY STATE AND DECLARE AS FOLLOWS:

Credentials

1. I hold a Bachelor of Science degree from Gonzaga University and a Master of Science degree from the University of Washington. Since August of 1991 I have been employed as an assistant harvest manager and fisheries data manager for the Yakama Nation fisheries program. My duties have included data collection, synthesis, and technical analysis in support of Yakama Nation research and policy strategies to achieve the restoration of historically present salmon populations throughout the Yakima and Columbia River Basins. I served as chair of the U.S. v Oregon Technical Advisory Committee from 1996-1999. I am lead author or co-author of five publications in the peer-reviewed literature and have also authored or co-authored a number of technical reports in the U.S. v Oregon and Bonneville Power Administration public record.

Purpose

2. The purpose of my declaration is to provide evidence from available data and the literature which supports the theory that supplementation using hatchery-origin fish can be used to maintain or improve viable salmon population (VSP) parameters (abundance, productivity, spatial structure, and diversity; McElhany et al. 2000). Specifically, I seek to advise the court of the success of several supplementation programs in the Yakima, the upper Columbia, and the Snake River Basins, involving spring Chinook, fall Chinook, coho and steelhead. These are the types of carefully implemented supplementation programs contemplated for development and implementation in the mid and upper Columbia River under the recent Fish Accord Memorandums of Agreement (MOAs). These programs, over a period of years, through carefully proscribed supplementation protocols (e.g., HSRG 2005), have contributed to increases in the number of natural spawners (both listed and unlisted fish) in the river systems where they have been implemented.

3. My intent is not to argue that supplementation is the only path to delisting, as opposed to being just one of many tools available. However, I do want to indicate to the court the facts of the situation in Indian country, facts which other plaintiffs and even the United States have ignored or criticized. Salmon supplementation programs, for the most part being implemented at the tribes' urging and under tribal direction, are providing more natural spawners in numerous areas, a condition that most other proposed remedies have not yet proven able to achieve.

4. Unfortunately, when the court reviews the other declarations in this proceeding, it will find little or no mention of these tribal programs. In fact, Oregon's declaration includes a tacit disparagement of supplementation even as part of the recovery package beyond a "safety net" process. I find this most unfortunate, as not only the programs that I discuss below, but also the

literature I cite, are providing an increasing body of science supporting carefully planned and executed supplementation programs as a means of increasing viable spawning population parameters, of which abundance or the number of natural spawners is a key parameter. I note that for listed populations, the progeny of these natural spawners become part of the listed population upon emergence from the gravel and empirical studies indicate that these fish return and spawn as adult members of the listed population. Rather than debate the many theories about the effects of supplementation on fishery genetics, my intent is simply to inform the court that carefully designed and implemented supplementation programs actually put natural spawners in the river which, without argument, is a key element of salmon restoration and recovery.

5. The following are the supplementation programs with which I have worked and am most familiar.

Spring Chinook

6. The Cle Elum Supplementation and Research Facility (CESRF) is a large hatchery complex (central spawning and rearing facility with three acclimation sites) that was specifically designed to test scientific uncertainties in regard to the adequacy of spring Chinook hatchery supplementation for meeting production objectives and limiting adverse ecological and genetic impacts in the Yakima River Basin (BPA 1996). The CESRF is a central part of the Yakima-Klickitat Fisheries Project (YKFP) which includes a large (~$4.0 million annual budget) monitoring and evaluation component. The CESRF collected its first spring Chinook brood stock in 1997, released its first fish in 1999, and age-4 adults have been returning since 2001, with the first F2 generation (offspring of CESRF and wild fish spawning in the wild) returning as

adults in 2005. Only wild or natural-origin fish are taken for brood stock in the CESRF program and used to propagate fish which are allowed to spawn in the wild.

7. The Tucannon Fish Hatchery (TFH) is part of the Lower Snake River Compensation Plan (LSRCP) that was authorized by Congress to help mitigate for the losses of salmon and steelhead runs due to construction and operation of the Snake River dams. One of the hatchery's objectives is to compensate for the estimated annual loss of 1,152 Tucannon River spring Chinook salmon adults caused by hydroelectric projects on the Snake River. The TFH operates as a supplementation program and the Washington Department of Fish and Wildlife (WDFW) has been evaluating the success of the TFH in meeting the mitigation goal, and identifying factors that would improve performance of the hatchery fish (Gallinat and Ross 2007). This too is a carefully monitored program using local fish from the Tucannon river area and incorporates a large percentage of natural-origin fish into the brood stock.

9. The following figures and discussion document some of the preliminary results from these two programs.

10. Figure 1. Actual returns (green bar) of age-4 Upper Yakima spring chinook to the Yakima River mouth compared to estimated returns if the Cle Elum Supplementation and Research Facility (CESRF) had not been constructed. Data are for return years 2001-2007, the first seven years of age-4 returns from the CESRF.

11. Methods and Discussion: Brood stock for the CESRF program are collected, and adult returns are enumerated at Roza Dam located in the mid-Yakima River about 200 kilometers upstream of its confluence with the Columbia River. For all years, actual returns with supplementation (green bars) are derived from actual counts of marked (CESRF) and unmarked (wild/natural) fish at Roza Dam backed through harvest to the Yakima River mouth. For F1

returns (returns from wild fish spawned in the hatchery) in 2001-2004, the yellow bars (estimated returns without supplementation) are calculated as the actual returns of unmarked (wild) fish at Roza backed to the river mouth plus estimated returns from fish taken for CESRF broodstock had these fish been allowed to spawn in the wild and returned at observed wild/natural return per spawner rates. For F2 and later generation returns from 2005 forward (where wild/natural returns are comprised of crosses of wild/natural and CESRF fish spawning together in the wild), estimated returns without supplementation are calculated as if the estimated "without supplementation" return four years earlier had been the total escapement, spawned in the wild, and their progeny returned at observed wild/natural return per spawner rates. Using this method the estimated benefit (increase in abundance of natural spawners) from supplementation ranged from 13% in return year 2003 to 137% in return year 2006 and averaged 75% from 2001-2007.

12. Figure 2. Return per spawner (adult-to-adult productivity) rates for natural- (red bars) and hatchery-origin (yellow bars) spring Chinook in the Tucannon and Yakima Rivers.

13. Methods and Discussion: Note the proportion of time the natural (red bars) returns are at or below the replacement (blue) line. For the Tucannon River, based on adult returns from the 1985-2002 broods, naturally reared salmon produced only 0.6 adults for every spawner, while hatchery reared supplementation fish produced 1.7 adults. For the Yakima River, based on adult returns from the 1997-2003 broods, naturally reared salmon produced only 1.1 adults for every spawner, while hatchery reared supplementation fish produced 5.2 adults. As reported in Gallinat and Ross (2007), "in many ways the hatchery program has helped conserve the natural population by returning adults to spawn in the river".

14. Figure 3. Teanaway River Spring Chinook Redd Counts, 1981 – 2007 and changes in the spatial distribution and percentage of natural origin spawners since CESRF fish began returning to the natural spawning grounds in 2002

15. Methods and Discussion: Redd surveys in the Yakima River Basin have been conducted annually by Yakama Nation staff since 1981. Of critical importance to the scientific debate over the validity of supplementation increases are the redd survey totals for the upper Yakima R. and Naches R. (a major tributary of the Yakima river, which joins the Yakima R. in the city of Yakima at about river kilometer 187, and which is used as a control stream for the CESRF study). Redd surveys conducted from 1981 to 2006 indicated that the number of spawners increased for both populations during the post-supplementation period (2001-2006) but the average number of redds increased 247% in the upper Yakima vs. 201% for the unsupplemented Naches River (May et al. 2007). These results suggest that supplementation increased the number of spawners in the upper Yakima beyond the natural increases associated with improved ocean survival. These empirical data contradict the claims of those who say improved ocean productivity is solely or primarily responsible for the increase in adult returns observed in recent years for many Columbia River salmon populations. To the best of my knowledge, this is one of few and perhaps the only study of closely connected tributaries like the Yakima and the Naches that deals precisely with this issue. As I note the figures are clear that during the 6 years of the study, regardless of ocean conditions, naturally spawning fish increased significantly in the supplemented Yakima arm above those in the unsupplemented Naches. Thus, it is incorrect for anyone to assert that abundance increases in supplemented streams are solely due to ocean conditions and not, at least in part, to supplementation.

16. The Jack Creek acclimation site located on the Teanaway River, another tributary of the Yakima river located near Cle Elum Washington (~rkm 280), began releasing CESRF spring chinook in 1998, with the first age-4 females returning from these releases in 2002. The acclimation sites were designed with the specific intent to allow fish to imprint and return to spawn in the river (as opposed to a hatchery). In 2006, the first year offspring of naturally spawning supplementation fish returned, the percentage of "natural origin" spawners increased from 0.25-1.23 % to 4.27% (May et al. 2007). These data and an increase in the number of redds from 3.0 (± 1.82) to 69.0 (± 22.1) since the initiation of juvenile releases from the Jack Creek acclimation site suggest that supplementation fish spawn successfully in the wild and have the ability to greatly increase the numbers of natural fish in the river.

17. As a critical component of the CESRF program, the Yakamas are implementing significant habitat improvements in the river so that when the fish return they have much improved spawning and rearing conditions, which I and others on our team believe contribute substantially to the ongoing success of this program. This is precisely the type of combined effort that will be implemented in the mid and upper Columbia under the BIOP and the MOA. Like the "Field of Dreams", the intent is to not only build the field (habitat improvement), but also to go a step further and provide the bats and balls (supplementation) so that "they will come".

18. For additional data and supporting information, see:

Bosch, B. 2008. Summary of Data Collected by the Yakama Nation relative to Yakima River Spring Chinook Salmon and the Cle Elum Spring Chinook Supplementation and Research Facility. Appendix A in Sampson et al., Yakima/Klickitat Fisheries Project Monitoring and Evaluation; Yakima Substation, 2007-2008 Annual Report, Project No. 199506325, 228 electronic pages, (BPA Report DOE/BP-00035037-1).

Coho

Yakima Basin

19. Historical returns of coho salmon to the Yakima River Basin were estimated to range from 45,000 to 100,000 fish annually but declined to zero by the 1980s after decades of overexploitation of fishery, water, and habitat resources. In 1996, the Yakama Nation and cooperators initiated a project to determine the feasibility of reestablishing a naturally spawning coho population in the Yakima River.

20. The project explored the feasibility of successful coho salmon recolonization in the Yakima River by introducing stocks that had been reared in hatcheries for multiple generations. Such a program was and remains highly controversial as some science has suggested that strongly "domesticated fish" are limited in their ability to survive and reproduce successfully. After 10-20 years of outplanting, we compared data for adult returns of known natural origin (i.e., returns from parents that spawned in the wild, but which were the progeny of the original hatchery plants) and returns from hatchery releases. We found that fish of natural origin returned at a significantly larger size than those of hatchery origin. The mean egg mass and mean egg size of natural-origin females were greater than those of hatchery-origin females, but the differences were statistically significant for only one of three sample years. Natural-origin adults returned 2-9 d later and spawned 5 d later than their hatchery-origin counterparts. Preliminary indices of smolt-to-adult survival for natural-origin fish were 3.5 to 17.0 times survival indices of hatchery-origin fish. The number of returns to the historical spawning habitats in upriver areas generally increased. Spawning surveys demonstrated the existence of robust and sustainable spawning aggregates in various locations in the basin, all of which were descendants of the original hatchery fish, suggesting that even strongly "domesticated" hatchery fish have the ability to re-colonize vacant habitats, an innate and critical characteristic which has contributed to the long-term success of salmon populations (Anderson and Quinn 2007).

21. Hatchery releases from the local brood source (Yakima River hatchery- and natural-origin returns) had significantly higher smolt-to-smolt survival than releases from out-of-basin (non-Yakima River) hatchery broodstock, but some of these observed differences in survival may be partially attributable to differences in smolt size.

22. We concluded that hatchery-origin coho salmon with a legacy of as many as 10-30 generations of hatchery influence, demonstrated an ability to reestablish themselves in the Yakima River (i.e., as a naturalized, nonnative population) after as few as 3-5 generations of outplanting in the wild (Bosch et al 2007). This has increased the number of natural-origin coho spawners in the Yakima from zero to an average of over 1,000 fish annually over the course of this process, a rather stunning example of the use of carefully planned and executed supplementation programs.

Mid-Columbia Basin

23. Efforts similar to those in the Yakima Basin have been ongoing in the Wenatchee and Methow River Basins since 1996. Demonstrated progress to date includes dramatic increases in abundance (Figure 4), establishment of a local broodstock from the same "domesticated" lower river stocks used in the Yakima, and observed evidence of sustained and increasing natural production (Yakama Nation 2005). Coho were functionally extinct in the mid Columbia as recently as 1998 when the count at Rock Island dam (near Wenatchee Washington) was zero. With the Yakama supplementation plan for the mid-Columbia, which follows and improves upon the successful Yakima plan, Rock Island adult coho counts in 2007 exceeded 16,000 fish! Many of those fish were destined to spawn in the wild. These fish, supposedly "unfit" in the opinion of many supplementation critics, were able to travel downstream through 7 dams, survive one to two years in the ocean and return back upstream through those seven dams to their stream of

origin. This is another example of a stunning revival of an extirpated stock using careful and well implemented supplementation concepts and programs.

Figure 4. Counts of Adult Coho at McNary and Rock Island Dams, 1986-2007. (data source: Univ. of Washington Data Access in Real-Time)

Fall Chinook

24. Snake River fall Chinook have been listed as "threatened" under the Endangered Species Act since 1992. As a result of litigation in 1994 and a subsequent negotiated settlement between the parties to United States v. Oregon, the parties agreed to begin outplanting hatchery-reared Snake River fall Chinook above Lower Granite Dam. Since 1996, fall Chinook yearlings and subyearlings from the Lyons Ferry Hatchery have been outplanted to Pittsburgh Landing and Captain John's Rapids, both on the mainstem Snake River, and at Big Canyon on the Clearwater River. The Nez Perce Tribe has taken the lead in the Snake River fall Chinook supplementation program at these facilities.

25. Since the supplementation program began, abundance of fall Chinook returning to Lower Granite Dam has dramatically increased (Figure 5). In addition to increased returns, counts of redds have increased each year as well indicating the supplementation fish are returning to the release areas and spawning (D. Johnson, Nez Perce Tribe, personal communication).

26. While other factors (e.g., ocean conditions, passage improvements, and harvest reductions) may have played a role in the dramatic return of fall Chinook to the Snake River Basin above Lower Granite Dam, increases in natural escapement above Lower Granite are strongly correlated with releases and aggregate returns from the supplementation program. Thus, it is reasonable to conclude that supplementation was at least partially responsible for the increased abundance of natural-origin fall Chinook in the Snake River Basin.

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30. Figure 5. Counts of aggregate and natural-origin adult fall Chinook salmon at Lower Granite Dam, and releases[1] of fall Chinook salmon from Snake River supplementation programs, 1983 to present.

(data sources: WDFW, ODFW, and U.S. v OR TAC technical documents, Univ. of WA Data Access in Real-Time, and Fish Passage Center)

[1] Estimated total release of yearling and subyearling fish combined divided by 200 fish.

31. Literature Review

The following are brief synopses from recent publications in the peer-reviewed literature supporting the theory that supplementation using hatchery-origin fish can maintain or positively influence VSP parameters.

Araki, H., W. R. Ardren, E. Olsen, B. Cooper, and M. S. Blouin. 2007. Reproductive success of captive-bred steelhead trout in the wild: evaluation of three hatchery programs in the Hood River. Conservation Biology 21 (1), 181-190.

Synopsis: Steelhead from a supplementation hatchery (reared in a supplementation hatchery and then allowed to spawn naturally in the wild) had reproductive success indistinguishable from that of wild fish. In contrast, fish from a traditional hatchery (nonlocal origin, multiple generations in hatcheries) breeding in the same river showed significantly lower fitness than wild fish. In addition, crosses between wild fish and supplementation fish were as reproductively successful as those between wild parents. Thus, there was no sign that supplementation fish drag down the fitness of wild fish by breeding with them for a single generation. On the other hand, crosses between hatchery fish of either type (traditional or supplementation) were less fit than expected, suggesting a possible interaction effect. These are the first data to show that a supplementation program with native brood stock can provide a single-generation boost to the size of a natural steelhead population without obvious short-term fitness costs.

Baumsteiger, J., D. M. Hand, D. E. Olson, R. Spateholts, G. FitzGerald, and W. R. Ardren. 2008. Use of Parentage analysis to Determine Reproductive Success of Hatchery-Origin Spring Chinook Salmon Outplanted into Shitike Creek, Oregon. North American Journal of Fisheries Management, 28:1472-1485.

Synopsis: This study shows that, under the right conditions, outplanted adult hatchery fish taken from localized hatchery stocks can contribute to the overall juvenile production in a natural stream.

Berejikian, B. A., T. Johnson, R. Endicott, and J. Lee. 2008. Increases in Steelhead Redd Abundance Resulting from Two Conservation Hatchery Strategies in the Hamma Hamma River, WA. Canadian Journal of Fisheries and Aquatic Sciences, 65:754-764.

Synopsis: The conservation hatchery program for steelhead evaluated in this study caused an increase in the number of redds in the supplemented Hamma Hamma River compared to the pre-supplementation period. Three control populations (non-supplemented) either remained stable or declined over the same period. The increase in redds from hatchery-produced spawners did not reduce the redd production from natural-origin spawners. A demographic boost to the naturally spawning population was affected while managing to minimize negative ecological consequences.

Bosch, W. J., D. E. Fast, D. R. Hatch, J. W. Blodgett, R. Branstetter, T. H. Newsome, and M. V. Johnston. 2008. Reconditioning kelt steelhead: A novel management strategy for populations in low abundance. Presented as poster at Western Division American Fisheries Society meeting, May 4-8, 2008. Yakama Nation Fisheries Resource Management, Toppenish, WA.

Synopsis: We reconditioned steelhead kelts in short- and long-term programs in a five-year study. Short-term reconditioned kelts were fed for approximately 3-11 weeks, transported around Columbia River hydroelectric facilities and released, with natural rearing and gonad rematuration occurring in the ocean. In long-term reconditioning, kelts were reared for 6-10 months then released locally. Survival to release for short-term reconditioning ranged from 69-93% and averaged 79%. Post-release survival and return of short-term kelts ranged from 1-9% with returning "ocean-reared" kelts showing an average weight gain of 46%. Survival to release for long-term reconditioning ranged from 19-62% and averaged 36% with captive-reared kelts showing an average weight gain of 38%. Short- and long-term reconditioned steelhead kelts represented 2-11% of the annual spawning escapement from 2001 to 2005 compared to a repeat spawning rate of 1.6% from the literature. Radio telemetry results demonstrated success in locating spawning grounds and constructing redds.

Under the BIOP and the MOA, a program similar to this will be implemented in the mid and upper Columbia with the goal of increasing VSP parameters for listed steelhead. This program will be evaluated closely for effects on the listed stocks of steelhead in those watersheds.

Brannon, E. L., D. F. Amend, M. A. Cronin, J. E. Lannon, S. LaPatra, W. J. McNeil, R. E. Noble, C. E. Smith, A. J. Talbot, G. A. Wedemeyer, and H. Westers. 2004. The controversy about salmon hatcheries. Fisheries 29(9): 12-30.

Synopsis: Reviews literature that has been often cited to show the negative effects of hatcheries and explains how poor experimental designs or the use of inappropriate (e.g., non-local origin, multiple generations in hatcheries) hatchery stocks contributed to the negative results reported in these papers. Documents many examples where fish from traditional hatcheries have spawned successfully and done well under natural conditions.

Heggenes, J., M. Beere, P. Tamkee, and E. B. Taylor. 2006. Genetic diversity in steelhead before and after conservation hatchery operation in a coastal, boreal river. Transactions of the American Fisheries Society 135:251-267.

Synopsis: The objectives of this study were to (1) investigate the genetic diversity of wild steelhead populations in the river before hatchery stocking and (2) assess the potential genetic impacts of interbreeding of returning hatchery adult fish with wild spawners over almost 20 years of large-scale hatchery operation. The level of population subdivision among Kitimat River samples was low (0.004) and not significantly different from 0. Tests of population subdivision between prehatchery and posthatchery operation indicated no significant changes. Similar results were obtained using other measures of genetic differentiation (principal components analysis of microsatellite allele frequencies and Cavalli-Sforza genetic distance). Our data, however, did indicate a slight but significant reduction in allelic richness after hatchery stocking. Pairwise tests for genetic differentiation among samples from different yearclasses were nonsignificant. We conclude that for the current management regime there is little apparent impact of hatchery practices on either the genetic structure or variation within the lower main-stem Kitimat River steelhead, but there may be a reduction in rare alleles. The practice of using substantial numbers of wild fish and multiple year-classes in the hatchery may have minimized genetic changes via genetic drift.

Kassler, T. W., D. K. Hawkins, and J. M. Tipping. 2008. Summer-Run Hatchery Steelhead

Have Naturalized in the South Fork Skykomish River, Washington. Transactions of the American Fisheries Society 137:763-771.

Synopsis: This study documents that Skamania Hatchery-origin steelhead have naturally produced offspring that are returning to spawn in a northern Puget Sound river basin. The study also suggests that the naturally produced offspring of the Skamania hatchery-origin fish may be increasing the overall number of alleles present in the natural population, thus enhancing overall genetic diversity.

Knudsen, C.M., S.L. Schroder, C. Busack, M.V. Johnston, T.N. Pearsons, and C.R. Strom. 2008. Comparison of Female Reproductive Traits and Progeny of First-Generation Hatchery and Wild Upper Yakima River Spring Chinook Salmon. Transactions of the American Fisheries Society 137:1433-1445.

Synopsis: "Our data support the idea that a single generation of state-of-the-art conservation hatchery propagation can produce fish with reproductive traits similar to those of wild fish, given comparable body size".

Pearsons, T. N. and G. M. Temple. 2007. Impacts of Early Stages of Salmon Supplementation and Reintroduction Programs on Three Trout Species. North American Journal of Fisheries Management 27:1-20.

Synopsis: "Our data indicate that early stages of salmon supplementation have not impacted trout species in the upper Yakima River basin beyond predetermined containment objectives."

Phillips, J.L., J. Ory and A. Talbot. 2000. Anadromous salmonid recovery in the Umatilla River Basin, Oregon: A case study. Journal of the American Water Resources Association, Vol. 36, no. 6, pp. 1287-1308. Dec 2000.

Synopsis: The mean adult-to-adult return rate of hatchery-reared steelhead exceeded replacement and that of the naturally-spawning population. Although the smolt-to-adult survival rates of hatchery-reared fish fluctuate, salmonid escapement has increased in recent years, permitting steelhead and spring chinook harvest. Enumeration of potential spawners and observed redds reveals an increase in natural production of all supplemented species.

Schroder, S. L., C. M. Knudsen, T. N. Pearsons, T. W. Kassler, S. F. Young, C. A. Busack, and D. E. Fast. 2008. Breeding Success of Wild and First-Generation Hatchery Female Spring Chinook Salmon Spawning in an Artificial Stream. Transactions of the American Fisheries Society, 137:1475-1489.

Synopsis: No differences were detected in the egg deposition rates of wild and hatchery females. Pedigree assignments based on microsatellite DNA, however, showed that the eggs deposited by wild females survived to the fry stage at a 5.6% higher rate than those spawned by hatchery females. Subtle differences between hatchery and wild females in redd abandonment, egg burial, and redd location choice may have been responsible for the difference observed. Body size did not affect the ability of females to spawn or the survival of their deposited eggs. How long a female lived was positively related to her breeding success but female origin did not affect longevity. The density of females spawning in portions of the stream affected both egg deposition and egg-to-fry survival. No difference, however, was found in the overall distribution patterns of the two types of females.

Schroder, S. L., C. M. Knudsen, T. N. Pearsons, S. F. Young, T. W. Kassler, D. E. Fast, and B. D. Watson. 2006. Comparing the Reproductive Success of Yakima River Hatchery- and Wild-Origin Spring Chinook. Yakima/Klickitat Fisheries Project Monitoring and Evaluation, Annual Report 2005. BPA Report DOE/BP-00022370-3.

Synopsis: "Reproductive success in wild- and first generation hatchery-origin spring Chinook males was examined by allowing the fish to compete for spawning opportunities in two sections of an observation stream. No differences were detected in reproductive success due to hatchery or wild origin. Nor were any behavioral differences found between hatchery and wild males."

Sharma, R, G. Morishima, S. Wang, A. Talbot, and L. Gilbertson. 2006. An evaluation of the Clearwater River supplementation program in western Washington. Canadian Journal of Fisheries and Aquatic Sciences, Volume 63, Number 2, 1 February 2006, pp. 423-437(15).

Synopsis: After three generations of study, an integrated coho supplementation program in a Washington coastal stream documented no empirical evidence that the program negatively affected the fitness of the target population. This study demonstrates that a supplementation (hatchery) program, in this case following new and innovative operational protocols, can produce smolts that have nearly the same survival rate to adults as that of wild smolts and can result in more adult coho returning to the Clearwater basin. This benefit appears possible without short-term adverse impacts to either intrinsic productivity or the number of naturally produced smolts.

Tymchuk, W. E., C. Biagi, R. Withler, and R. H. Devlin. 2006. Growth and behavioral consequences of introgression of a domesticated aquaculture genotype into a native strain of coho salmon. Transactions of the American Fisheries Society 135:442-455.

Synopsis: The study found phenotypic differences between farmed and natural-origin fish. However, the differences were largely a consequence of additive gene action, and the phenotypic effects of domestication were largely diluted within two generations of backcrossing to wild salmon.

Summary and Conclusions

32. The effectiveness of hatchery supplementation programs can be assessed by evaluating the effects of these programs on viable salmon population parameters: abundance, productivity, spatial structure, and diversity. Empirical studies of hatchery supplementation programs that have documented increases in abundance or real or potential increases in production from natural-origin spawners include: CESRF spring Chinook (Figures 1-3; May et al. 2007); Tucannon spring Chinook (Figure 2; Gallinat and Ross 2007); Yakima Basin coho (Bosch et al. 2007); mid-Columbia Basin coho (Figure 4; Yakama Nation 2005); Snake River fall Chinook (Figure 5); Araki et al. 2007; Baumsteiger et al. 2008; Berejikian et al. 2008; Bosch et al. 2008; Kassler et al. 2008; Phillips et al. 2000; and Sharma et al. 2006. Empirical studies of hatchery

supplementation programs that have documented increases in spatial structure of natural-origin spawners include: CESRF spring Chinook (Figure 3; May et al. 2007); Yakima Basin coho (Bosch et al. 2007); mid-Columbia Basin coho (Yakama Nation 2005); and Snake River fall Chinook (D. Johnson, Nez Perce Tribe, personal communication). Empirical studies of hatchery supplementation programs that have documented minimal adverse (or in some cases positive) impacts to reproductive fitness parameters, genetic or ecological diversity include: Araki et al. 2007; Berejikian et al. 2008; Heggenes et al. 2006; Kassler et al. 2008; Knudsen et al. 2008; Pearsons and Temple 2007; Schroder et al. 2006; Schroder et al. 2008; and Sharma et al. 2006. Empirical studies of hatchery supplementation programs that have documented that any potential adverse phenotypic effects of domestication due to long-term hatchery influence can be reversed in relatively short order with re-introduced wild influence include: Bosch et al. 2007; Tymchuk et al. 2006; and Yakama Nation 2005.

33. In conclusion, it is my opinion that supplementation programs such as those carried out by the Yakama Nation and the other programs described in this declaration, especially when paired with the habitat recovery programs set forth in the Biological Opinion and the Fish Accord MOA's, are scientifically valid methods of increasing naturally spawning listed salmon and steelhead populations. Experience and the literature suggest that success for supplementation programs is most likely when fish are taken from local, natural-origin fish. This will be the case in the mid and upper Columbia, where programs will begin with broodstock taken from listed fish from the streams to be supplemented, due to the availability of the fish and trapping facilities. This will be a huge benefit to getting the programs up and running in a much shorter period of time than if we had to start from scratch in developing a proper broodstock.

34. References

Anderson, J. H. and T. P. Quinn. 2007. Movements of adult coho salmon (*Oncorhynchus kisutch*) during colonization of newly accessible habitat. Canadian Journal of Fisheries and Aquatic Sciences, 64:1143-1154.

Bosch, W. J., T. H. Newsome, J. L. Dunnigan, J. D. Hubble, D. Neeley, D. T. Lind, D. E. Fast, L. L. Lamebull, and J. W. Blodgett. 2007. Evaluating the Feasibility of Reestablishing a Coho Salmon Population in the Yakima River, Washington. North American Journal of Fisheries Management 27:198-214.

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May, D., D. Larsen, M. Moser, D. Fast, M. Johnston, and A. Dittman. 2007. Spatial patterns of Yakima River spring Chinook spawning before and after supplementation. AFS poster presentation, national meeting, San Francisco, CA, Sept. 2007. NOAA Northwest Fisheries Science Center, Seattle, WA.

McElhany, P., M. H. Rucklelshaus, M. J. Ford, T. C. Wainwright, and E. P. Bjorkstedt. 2000. Viable Salmonid Populations and the Recovery of Evolutionarily Significant Units. NOAA Technical Memorandum NMFS-NWFSC-42. NOAA Northwest Fisheries Science Center, Seattle, WA.

Yakama Nation. 2005. Mid-Columbia Coho Restoration Master Plan. Yakama Nation Fisheries Resource Management. Toppenish, WA. Peer-reviewed by the Independent Scientific Review Panel, available at: http://www.nwcouncil.org/library/isrp/isrp2006-5.pdfT. W., D. K. Hawkins, and J. M. Tipping. 2008. Summer-Run Hatchery Steelhead Have Naturalized in the South Fork Skykomish River, Washington. Transactions of the American Fisheries Society 137:763-771.

Synopsis: This study documents that Skamania Hatchery-origin steelhead have naturally produced offspring that are returning to spawn in a northern Puget Sound river basin. The study also suggests that the naturally produced offspring of the Skamania hatchery-origin fish may be increasing the overall number of alleles present in the natural population, thus enhancing overall genetic diversity.

Knudsen, C.M., S.L. Schroder, C. Busack, M.V. Johnston, T.N. Pearsons, and C.R. Strom. 2008. Comparison of Female Reproductive Traits and Progeny of First-Generation Hatchery and Wild Upper Yakima River Spring Chinook Salmon. Transactions of the American Fisheries Society 137:1433-1445.

Synopsis: "Our data support the idea that a single generation of state-of-the-art conservation hatchery propagation can produce fish with reproductive traits similar to those of wild fish, given comparable body size".

Pearsons, T. N. and G. M. Temple. 2007. Impacts of Early Stages of Salmon Supplementation and Reintroduction Programs on Three Trout Species. North American Journal of Fisheries Management 27:1-20.

Synopsis: "Our data indicate that early stages of salmon supplementation have not impacted trout species in the upper Yakima River basin beyond predetermined containment objectives."

Phillips, J.L., J. Ory and A. Talbot. 2000. Anadromous salmonid recovery in the Umatilla River Basin, Oregon: A case study. Journal of the American Water Resources Association, Vol. 36, no. 6, pp. 1287-1308. Dec 2000.

Synopsis: The mean adult-to-adult return rate of hatchery-reared steelhead exceeded replacement and that of the naturally-spawning population. Although the smolt-to-adult survival rates of hatchery-reared fish fluctuate, salmonid escapement has increased in recent years, permitting steelhead and spring chinook harvest. Enumeration of potential spawners and observed redds reveals an increase in natural production of all supplemented species.

Schroder, S. L., C. M. Knudsen, T. N. Pearsons, T. W. Kassler, S. F. Young, C. A. Busack, and D. E. Fast. 2008. Breeding Success of Wild and First-Generation Hatchery Female Spring Chinook Salmon Spawning in an Artificial Stream. Transactions of the American Fisheries Society, 137:1475-1489.

Synopsis: No differences were detected in the egg deposition rates of wild and hatchery females. Pedigree assignments based on microsatellite DNA, however, showed that the eggs deposited by wild females survived to the fry stage at a 5.6% higher rate than those spawned by hatchery females. Subtle differences between hatchery and wild females in redd abandonment, egg burial, and redd location choice may have been responsible for the difference observed. Body size did not affect the ability of females to spawn or the survival of their deposited eggs. How long a female lived was positively related to her breeding success but female origin did not affect longevity. The density of females spawning in portions of the stream affected both egg deposition and egg-to-fry survival. No difference, however, was found in the overall distribution patterns of the two types of females.

Schroder, S. L., C. M. Knudsen, T. N. Pearsons, S. F. Young, T. W. Kassler, D. E. Fast, and B. D. Watson. 2006. Comparing the Reproductive Success of Yakima River Hatchery- and Wild-Origin Spring Chinook. Yakima/Klickitat Fisheries Project Monitoring and Evaluation, Annual Report 2005. BPA Report DOE/BP-00022370-3.

Synopsis: "Reproductive success in wild- and first generation hatchery-origin spring Chinook males was examined by allowing the fish to compete for spawning opportunities in two sections of an observation stream. No differences were detected in reproductive success due to hatchery or wild origin. Nor were any behavioral differences found between hatchery and wild males."

Sharma, R, G. Morishima, S. Wang, A. Talbot, and L. Gilbertson. 2006. An evaluation of the Clearwater River supplementation program in western Washington. Canadian Journal of Fisheries and Aquatic Sciences, Volume 63, Number 2, 1 February 2006, pp. 423-437(15).

Synopsis: After three generations of study, an integrated coho supplementation program in a Washington coastal stream documented no empirical evidence that the program negatively affected the fitness of the target population. This study demonstrates that a supplementation

(hatchery) program, in this case following new and innovative operational protocols, can produce smolts that have nearly the same survival rate to adults as that of wild smolts and can result in more adult coho returning to the Clearwater basin. This benefit appears possible without short-term adverse impacts to either intrinsic productivity or the number of naturally produced smolts.

Tymchuk, W. E., C. Biagi, R. Withler, and R. H. Devlin. 2006. Growth and behavioral consequences of introgression of a domesticated aquaculture genotype into a native strain of coho salmon. Transactions of the American Fisheries Society 135:442-455.
Synopsis: The study found phenotypic differences between farmed and natural-origin fish. However, the differences were largely a consequence of additive gene action, and the phenotypic effects of domestication were largely diluted within two generations of backcrossing to wild salmon.

Summary and Conclusions

35. The effectiveness of hatchery supplementation programs can be assessed by evaluating the effects of these programs on viable salmon population parameters: abundance, productivity, spatial structure, and diversity. Empirical studies of hatchery supplementation programs that have documented increases in abundance or real or potential increases in production from natural-origin spawners include: CESRF spring Chinook (Figures 1-3; May et al. 2007); Tucannon spring Chinook (Figure 2; Gallinat and Ross 2007); Yakima Basin coho (Bosch et al. 2007); mid-Columbia Basin coho (Figure 4; Yakama Nation 2005); Snake River fall Chinook (Figure 5); Araki et al. 2007; Baumsteiger et al. 2008; Berejikian et al. 2008; Bosch et al. 2008; Kassler et al. 2008; Phillips et al. 2000; and Sharma et al. 2006. Empirical studies of hatchery supplementation programs that have documented increases in spatial structure of natural-origin spawners include: CESRF spring Chinook (Figure 3; May et al. 2007); Yakima Basin coho (Bosch et al. 2007); mid-Columbia Basin coho (Yakama Nation 2005); and Snake River fall Chinook (D. Johnson, Nez Perce Tribe, personal communication). Empirical studies of hatchery supplementation programs that have documented minimal adverse (or in some cases positive) impacts to reproductive fitness parameters, genetic or ecological diversity include: Araki et al. 2007; Berejikian et al. 2008; Heggenes et al. 2006; Kassler et al. 2008; Knudsen et al. 2008;

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36. In conclusion, it is my opinion that supplementation programs such as those carried out by the Yakama Nation and the other programs described in this declaration, especially when paired with the habitat recovery programs set forth in the Biological Opinion and the Fish Accord MOA's, are scientifically valid methods of increasing naturally spawning listed salmon and steelhead populations. Experience and the literature suggest that success for supplementation programs is most likely when fish are taken from local, natural-origin fish. This will be the case in the mid and upper Columbia, where programs will begin with broodstock taken from listed fish from the streams to be supplemented, due to the availability of the fish and trapping facilities. This will be a huge benefit to getting the programs up and running in a much shorter period of time than if we had to start from scratch in developing a proper broodstock.

I hereby declare that the above statement is true to the best of my knowledge and belief, and that I understand it is made for use as evidence in court and is subject to penalty for perjury.

DATED this 24th day of September, 2008.

s/William J. Bosch
WILLIAM J. BOSCH

37. References

Anderson, J. H. and T. P. Quinn. 2007. Movements of adult coho salmon (*Oncorhynchus kisutch*) during colonization of newly accessible habitat. Canadian Journal of Fisheries and Aquatic Sciences, 64:1143-1154.

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by causing a full, true, and correct copy thereof to be sent by the following indicated method or methods, on the date set forth below:

☐ by mailing in a sealed, first-class postage-prepaid envelope, addressed to the last-known office address of the attorney, and deposited with the United States Postal Service at Bend, Oregon.

☐ by hand delivery.

☐ by sending via overnight courier in a sealed envelope.

☐ by faxing to the attorney at the fax number that is the last-known fax number for the attorney's office.

☒ by electronic service pursuant to LR 100.7.

DATED this 24th day of October, 2008.

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